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JOURNAL OF THE MASSACHUSETTS ASSOCIATION OF BOARDS OF HEALTH

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Vol. V. DECEMBER, 1895 No. 4

RECORDS OF

October Quarterly Meeting 1895

SUBJECTS: Inspection of Tuberculous Cattle in Massachusetts; Certificates of Death; Methods of Disinfection; Methods of Garbage Disposal.

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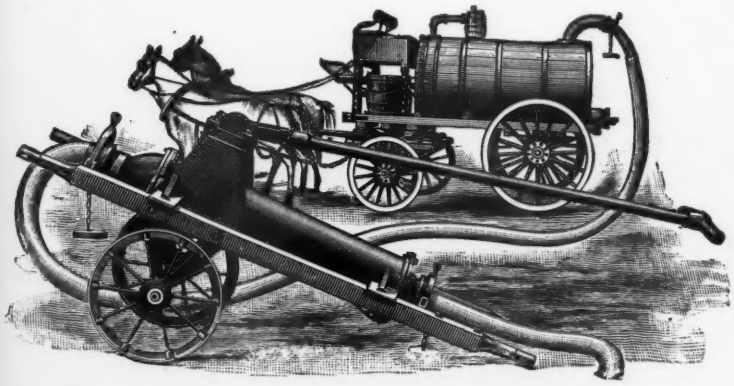

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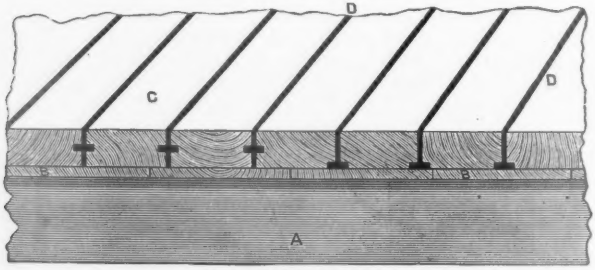

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THE JOURNAL OF THE MASSACHUSETTS ASSOCIATION OF BOARDS OF HEALTH.

THE MASSACHUSETTS ASSOCIATION OF BOARDS OF HEALTH was organized in Boston in March, 1890, with the following objects: the advancement of sanitary science in the Commonwealth of Massachusetts; the promotion of better organization and co-operation in the local Boards of Health; the uniform enforcement of sanitary laws and regulations; and the establishment of pleasant social relations among the members of the Association.

All persons holding appointments as members of a Board of Health in a Massachusetts city or town, the executive officers of such a local board, and the members of the State Board of Health are eligible to membership. Other persons may be elected members by vote of the Association. The annual dues are two dollars.

The Association holds four regular meetings each year, the annual or January meeting always being held in Boston.

THE OFFICIAL JOURNAL OF THE ASSOCIATION is a quarterly publication, containing the papers read at the meetings, together with verbatim reports of the discussions following them. No part of this matter is printed in any other periodical.

The JOURNAL will present, from quarter to quarter, a fair and adequate picture of the progress of practical sanitary science as applied to the needs of a modern community. The various subjects which are reviewed in the quarterly meetings of the Association are treated by experts qualified to speak from daily experience in Public Health offices, who, as men of science, are careful to be scientific and comprehensive, and who, as public officers, are no less careful to speak pertinently and so as to be easily intelligible to the layman.

The JOURNAL, in a word, appeals to all whose interests touch the questions of sanitation and hygiene,— to the architect, the school-committee-man, the manufacturer, the contractor, and, above all, to the busy practitioner who has no time for any reading but what is brief and to the point.

The subscription price of the JOURNAL is one dollar a year, payable in advance. Single numbers, twenty-five cents. It is on sale at the Old Corner Bookstore, Boston.

All communications to the Association should be addressed to the Secretary, Edwin Farnham, M.D., City Hall, Cambridge, Mass.

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MASSACHUSETTS ASSOCIATION OF BOARDS OF HEALTH.

Organized 1890.

[This Association as a body is not responsible for statements or opinions of any of its members.]

VOL. V. December, 1895. NO. 4

OCTOBER QUARTERLY MEETING

OF THE

Massachusetts Association of Boards of Health.

A quarterly meeting of the Massachusetts Association of Boards of Health was held at Brookline, in the Town Hall, on the afternoon of Tuesday, Oct. 22, 1895. Dr. S. H. Durgin, of Boston, presided, and after dinner called the Association to order at about three o'clock, and said: —

We have with us this afternoon a pioneer in bacteriology, the discoverer with Loefler of the diphtheria bacillus. I have the honor to present to you Professor Klebs, of Germany.

REMARKS OF PROFESSOR EDWIN KLEBS.

Mr. Chairman and Gentlemen,— I am but a short time in your land, and I do not speak English very well; but I must thank you for this reception that you have offered me. I am very glad to be in an association of men that will work for the prevention of disease. As I came here to America, I thought I must see that little land of Massachusetts; for in this land is fulfilled one of my first hygienic dreams. You must know that, when I was a young officer in Berne, Switzerland, I made some investigations in regard to tuberculosis; and I was obliged to differ in this from my old master and friend Virchow, who did not think that the tuberculosis of cattle was true

tuberculosis. I could demonstrate at this time, by experiments with animals, that, if the milk of tuberculous cows was injected cutaneously or given as food to guinea pigs, they would show tuberculosis. That was in the year 1867, nearly twenty-eight years ago. After this demonstration I could say certainly that cases of tuberculosis arise, as we all now know, from the milk of cows; and I spoke of this in Berlin and elsewhere to intelligent men. But the farmers said, "If you kill all my cattle, I will lose my money." However, after so long a time opinions have changed; and I was very glad to express in a meeting of this year in the first speech that I made here in America, at the American Medical Association, that Massachusetts is the first place to have a law introduced with this view. So you can think that I am very glad to meet you who are devoted to the consideration of these difficult questions of practical life. I thank you very much for your reception, and I hope that we shall again have the pleasure of meeting each other.

THE CHAIRMAN.— We have with us this afternoon a gentlemen who has been for over twenty-five years a member of the Brookline Board of Selectmen, a man who is esteemed by the citizens of the town for his long service as an honest and courageous man. I present to you the Hon. Horace James, of Brookline.

REMARKS OF HON. HORACE JAMES.

Mr. President and Gentlemen,— As the chairman of the Board of Selectmen, it becomes my very agreeable duty to extend to you on behalf of the town of Brookline a most cordial welcome on this occasion.

In this connection I desire to say that for such pleasure or profit as may be derived from this meeting our thanks are due primarily to Dr. Chase, the very efficient agent of our Board of Health, for the suggestion that we should invite you to meet with us at this time.

In the subjects which have been selected for discussion to-day we are particularly interested. At the present time the prevalence to a very unusual extent of contagious diseases makes the subject of efficient disinfection one of great importance. The best system of garbage disposal is a problem with which a special committee of the town have been wrestling, without success, for the past three years; and they will doubtless be most happy to receive new light upon the matter.

As a part of the programme of this day's proceedings, you were invited to visit our hospitals for contagious diseases, and also a portion of our waterworks. The town, though small in area and, until within a few years, in population, as compared with neighboring municipalities, has not been

behind them in providing such sanitary appliances, and in making and enforcing such regulations, as have been found needful for the safety and health of its inhabitants.

Among these things may be mentioned the hospitals for contagious diseases and a thoroughly good system of water supply and drainage. The hospitals, with the exception of the small-pox building, were built last year; and it is only within the last eighteen months that any urgent necessity existed for them, it having been practicable to take care of the few cases of contagious disease which occurred, at the homes of the patients.

The water-works were constructed in 1873, the population of the town at that time being about 7,000. It is now a little over 16,000. Had time permitted, we should have been pleased to have shown you our works at the source of supply in the West Roxbury district of Boston, where the water is drawn from filtering galleries and driven wells, and not from Charles River direct, as many suppose. In the construction and enlargement of the works and purchase of land for the protection of the water supply there has been spent something over $1,250,000, with the result that we have what is believed to be an ample supply for many years to come, and of a quality that is not excelled by any water supply in this part of the world. Our sewer system was commenced a few years prior to the water-works, and is being extended year by year, as required. The main sewer is connected with the Metropolitan System. This system of sewers and drains has cost to date nearly $1,000,000.

But we still need better public bathing facilities. A committee having this matter in charge have submitted a report which will come before the town for action at the meeting to be held on Thursday evening next; and, while the scheme is elaborate and costly, I have no doubt it will be adopted.

THE CHAIRMAN.— I take pleasure in introducing to you, gentlemen, Dr. Francis, one of the oldest members of the profession in Brookline, formerly a member of the Board of Health of this town, and in former years City Physician of Roxbury, at that time in charge of her contagious wards.

REMARKS OF DR. T. E. FRANCIS.

I did not expect, gentlemen, to be called upon. So I am not prepared to say anything particular to-day. I think that Mr. James has given you the principal facts with regard to the present Board of Health, and the care which is taken by this town to prevent infectious diseases. At the time that I was chairman of the board, it was a new board; and we had to

work against a great deal of opposition. Nearly everything which we introduced in the way of improvement was opposed by individuals who felt themselves disturbed by the objections which were made to their want of sewerage and their want of proper out-buildings. We were so successful and proved to be such an efficient board that at the end of the year the board was abolished [laughter]; and for myself, instead of being chairman of the Board of Health, I felt that I had been a bored chairman of health [renewed laughter].

All I have to say is, I am glad that you have now so efficient a board, so much more efficient than the board which was abolished when I was chairman.

THE CHAIRMAN.— I will call upon Dr. Sabine, who was for many years the agent of the Brookline Board of Health.

REMARKS OF DR. G. K. SABINE.

Mr. Chairman and Gentlemen,— I did not expect to be called upon to make any remarks. I am afraid I should not have come, had I expected it. While sitting here, I could not help thinking of the change which has taken place in regard to the working of the Board of Health since seventeen or eighteen years ago, the time to which Dr. Francis refers. Previous to that time I think there were no rules to prevent children attending school here from any house where there was any infectious disease, unless possibly the teacher found it out, and made the children stay away until such time as she might think it proper for them to return. The public carriages previous to that time were used frequently to convey dead bodies to the cemetery instead of a hearse; not only the bodies of those dead from non-infectious disease, but those from infectious disease. Many people all along the brook built drains which led into the brook. Now, of course, here as in other places, it is a very different matter. There has been a very great improvement, rules having been made to prevent children from infected houses attending school, the drainage taken out of the brook, and all of those rules established which exist in most places relative to health matters. As I say, the change which has been brought about in seventeen or eighteen years is certainly very great.

THE CHAIRMAN.— The next thing in order will be the reading of the records of the last meeting by the Secretary.

The records were accordingly read and approved.

THE CHAIRMAN.— The report of the Executive Committee will be omitted for the reason that the hour is late and there is very little before the committee to-day, and it will go over to the next meeting. Is there anything under the head of Incidental Business?

DR. H. LINCOLN CHASE.— Mr. Chairman, I move that the annual dues be reduced from three dollars to two dollars.

DR. JAMES B. FIELD.— To take effect when?

THE CHAIRMAN.— After the annual meeting in January.

The motion was seconded and unanimously adopted.

THE CHAIRMAN.— Is there anything else under the head of Incidental Business? If not, the next thing in order will be the report of the Committee on Death Certificates, S. W. Abbott, M.D., chairman.

THE SECRETARY.— Mr. Chairman, the report is rather an elaborate one; and Dr. Abbott does not feel able to read it to-day. It seems to me better, as long as we are rather pressed for time this afternoon, that this should go over until the next meeting, because I presume there would be some discussion of the subject; and it can be published in the next report.

It was voted that the report be printed and be a subject of discussion at the next quarterly meeting.

REPORT OF THE COMMITTEE ON CERTIFICATES OF DEATH.

Your committee has been requested by the terms of the vote passed at a recent meeting of the Association to "report a list of common terms used as causes of death which boards of health should not accept, and to formulate a certificate which shall be recommended for general use throughout the State." In this vote are embodied two distinct and definite subjects, both having for their object the improvement of the registration of deaths,— a movement which is in harmony with similar action which has been proposed often in the past and in several different countries.

Before proceeding to the subject-matter of this report, it is desirable to inquire, What is the object of the death certificate?

Its object is threefold:—

1. It furnishes a record of an important event in the history of the human being; and as such it presents definite evidence which may at any

future time be used in determining questions relative to the inheritance of property, in settling claims for life insurance and pensions, and in determining questions of survivorship and legitimacy. For these purposes, therefore, the record cannot be too minute in its details; and the greatest care should be exercised in complying with the statutes (Chapter 32 and the amendments thereto) to the fullest possible extent.

2. A clear and accurate record of a death serves as an effective aid in the detection and prevention of crime.

3. The collective opinion furnished by the accumulation and classification of large numbers of individual certificates of death constitutes the definite basis of very much of our medical knowledge, and extends its influence, in fact, to nearly every department of medical science, and especially to that which is the main object of this Association,—public hygiene. The cause of death, the sex, the age, the season of the year, the occupation, should all be stated with the greatest care and accuracy in each and every individual case, since the conclusions to be formed from the whole mass of returns must depend for their accuracy upon the accuracy of these individual certificates.

Medical science is pre-eminently progressive. Hence the terms used in designating the causes of death must necessarily be subject to change, from time to time, to conform to the progress of medical knowledge. Terms which were apparently correct in the early half of this century are now becoming obsolete, and those which we now use as current terms will perhaps in another generation be superseded. As an illustration, it is only necessary to go back twenty-five years in the registered records of the State to find typhus and typhoid fever constantly associated together under a single head as one disease. Hence any list of terms which we may prepare must be considered as temporary only. The same is true of all modern science. The engineer of to-day, in searching for abundant water supplies, discards the bygone superstition of the divining-rod for better and more exact methods of investigation.

In his day Dr. Farr was usually reckoned as the foremost English authority upon the classification and nomenclature of disease, but the generic terms indorsed by him are rapidly passing out of use. This assertion, however, is much more applicable to the generic than the specific terms employed in designating diseases. The terms "diathetic" and "enthetic," for example, as applied to groups of diseases, convey but little significance to the modern physician; and the newer nomenclatures are omitting all reference to the long-used term "zymotic," since the modern discoveries of bacteriologists have shown the true character of the diseases of this class. The *generic* fact that 2,015 persons died of *diathetic* diseases in 1893 in Massachusetts is one of far less import

than the *specific* fact that 1,533 out of this number died of *cancer* or that none were reported during the same year as having died of *gout*. The remark which Dr. Bertillon applies to certain diseases of pregnancy may as well be generalized when he says, "Some physicians willingly apply a definite title to certain diseases now; but no one knows just where we shall find them in the future."

But the terms of our instructions direct us to present a list of terms not to be accepted in written certificates of the causes of death. The following may be laid down as a rule which ought to be adopted and carried out as closely as possible: "To avoid the use of the names of symptoms whenever the names of diseases or of the causes of symptoms can with reasonable certainty be indicated." This was advised by the British Committee of Revision in 1885. It is, however, wise to study this rule carefully, especially with reference to the limitation following the word "whenever," since, as the same authorities definitely state: "The total rejection of symptoms as terms of the causes of deaths would only lead to reckless conjecture."

To follow this rule strictly may not always be possible for several reasons: —

1. Because the obscure nature of the illness or disease of which the person died may prevent an accurate statement.

2. The fact that the certifier or maker of the certificate is called in only at the last moment of life, or even after death, and that no autopsy is permitted, also must necessarily affect the accuracy of the certificate.

3. The age of the deceased also affects the accuracy of the certificate. It is safe to say that the number of defective and inaccurate certificates of the cause of death in infants under one year as well as among persons over seventy years of age — that is to say, at the two extremes of life — constitute fully one-half of the unsatisfactory and ill-defined returns which are received by registration officers. The inability of the tender infant to make known its symptoms limits the attending physician to the train of *objective* symptoms only for the purpose of diagnosis; and, while this is true of infancy, it is true also, though in less degree, at the other extreme of life,— the second childhood. Hence the frequent employment of such indefinite terms as "teething," "infantile causes," and "old age."

In immediate connection with the subject of this report, two improvements in the general registration system in the State suggest themselves, both of which are fortunately, at present, in practice in the city of Boston, the Board of Health of Boston having assumed authority to carry them out. We refer to the following: —

1. The power to require or obtain from the certifying person (usually a physician) further information in case of defective certificates. This

should be made an imperative duty by the enactment of a compulsory statute. It might be accomplished in either of two ways: —

(*a*) By imposing this duty on the general or state official having this work in charge. This duty has been assumed at times in Massachusetts by the State officer having charge of registration; but, since no requirement exists, the work has consequently been of a spasmodic character.

(*b*) The same requirement might be imposed upon the local registration officers, the town clerk and city registrars. The difficulty here, however, lies in the fact that by far the greater number of these consists of non-medical authorities, having little knowledge of the requirements necessary for the careful revision of death certificates.

The power to obtain this additional information is already assumed by the state registration officers of Maine, Michigan, and Minnesota; and there is no reason why Massachusetts should remain in the rear in this important matter.

2. The local authorities should also have power to make personal examination of all deaths where no attending physician was present. This power, which in several foreign countries is deputed to a special medical officer, and applies to *all* deaths, might be intrusted to the Board of Health or to the medical examiner of the district.

Your committee desires to call attention to the provisions of a proposed bill which the last legislature failed to pass, but which will undoubtedly be again presented during the coming session. While it may not be perfect in all its details, there are certain features which are worthy of note, and particularly those sections which require all public institutions, hospitals, and asylums which receive patients from without the municipality in which they are located to make separate mortality returns to the State, since it is not quite just that the municipalities should be burdened with the excessive death-rate which such institutions occasionally, and in some instances habitually, create. For example, the town of Bridgewater in 1892 and 1893 had a death-rate of about thirty-three per thousand; but a considerable part of this consisted of the mortality at the State Farm in that town, the actual death-rate of the town's population, exclusive of the inmates of this institution, being not far from sixteen per thousand.

We would further commend a perusal of Dr. Bertillon's report to the Statistical Congress at Chicago in 1893; and, since the entire report may not be accessible, the following paragraphs, slightly modified, are herewith reproduced. While they apply specially to the registering officer, they also contain valuable suggestions for the certifying physician.

RULES TO BE OBSERVED IN DOUBTFUL CASES.

The following are the general rules which we have adopted for the solution of certain difficulties (most frequently caused by incomplete diagnoses): —

I. *Incomplete Diagnosis.*

1. It is not the duty of a statistical office to interpret diagnosis (that is to say, to guess at what has been left incomplete). It can only register facts as they are formulated.

2. When an organ affected with disease is not specified, the certificate should be entered under the title "other organs."

For example, if the physician writes as cause of death "cancer," without specifying the organ attacked, the certificate should be classed under the title of "cancer of other organs."

3. An operation upon an organ (without specification of the cause which has necessitated the operation) leads us to suppose that this organ was diseased. Consequently, for lack of better information, a certificate in which the only cause of death noted is an operation upon an organ should be recorded under the title "other diseases of this organ."

For example, hysterotomy, given as a cause of death without other and more definite information, implies a diseased uterus. Hence the certificate which conveys this information should be classed under the title "other diseases of the uterus."

II. *Doubtful Diagnosis.*

1. In doubtful cases greater importance is attached to the seat of the disease than to its nature. For example, "for abscess of the prostate" there is no special title. It should be classed under "diseases of the prostate," and not under "abscess."

2. The presence of a foreign body in an organ should be considered as a disease of that organ. For example, a foreign body in the bladder given as a cause of death should be classed under the title "diseases of the bladder." Nevertheless, a "foreign body in the larynx" or "in the trachea" is to be considered as a cause of death by violence, and should be classed under that title.

III. *Choice between Two Simultaneous Diagnoses.*

Another question remains to be decided. It very often happens that two diseases are named at the same time as the causes of death: to which of

these causes shall the death be attributed? The following rules are given to solve this question: —

1. When death is attributed simultaneously to two diseases, it should first be ascertained whether one is not a complication. If this is found to be the case, then the death must be classed under the primary cause. Examples: —

Measles and convulsions, record as measles.
Measles and broncho-pneumonia, record as measles.
Scarlet fever and diphtheria, record as scarlet fever.
Scarlet fever and nephritis, record as scarlet fever.
Scarlet fever and eclampsia, record as scarlet fever.
Diabetes and bronchitis, record as diabetes.
Typhoid fever and pulmonary congestion, record as typhoid fever.
Whooping cough and pneumonia, record as whooping cough.
Cerebral hemorrhage and hemiplegia, record as cerebral hemorrhage.
Felon and purulent infection, record as felon.

2. If it is not absolutely certain (as in the preceding cases) that one of these diseases is the result of the other, the question should be settled whether there is not a considerable difference in the severity of the two diseases; and then the death should be recorded under the title of the more dangerous disease. For example, cirrhosis and fracture of the leg. One of these diseases is not the cause of the other. Cirrhosis being fatal, and fracture of the leg only exceptionally so, the death should be recorded as from cirrhosis.

A still more puzzling example, measles and phthisis. There is no proof that measles has been the cause of phthisis (although it may have hastened its progress). Phthisis being a more severe disease than measles, the death should be recorded under the title "phthisis."

This second example shows that the rule occasions some difficulties. The following suggestions may be adopted in certain doubtful cases: Deaths recorded as from

Measles and diphtheria, record as diphtheria.
Measles and small-pox, record as small-pox.
Measles and whooping cough, record as measles.
Apoplexy and senile debility, record as apoplexy.
Heart disease and softening of the brain, record as heart disease.
Cancer and pulmonary phthisis, record as cancer.

3. If the two causes of death are equally fatal, and neither appears to be caused by the other, the death should be recorded under that title which describes the case with the greatest accuracy. Generally, it is the more rare disease; and this is the name which the physician usually writes first. For example, diabetes and tuberculosis, record under diabetes.

The following list comprises the principal terms which your committee believe should be either avoided or modified or further explained when employed in certificates of death: —

Accident.— Specify the method or form.
Albuminuria.— A symptom only.
Anasarca.— A synonyme of dropsy, and usually a symptom only: specify the source or cause.
Anthrax.— A vague term: if *carbuncle* is meant, use preferably the English word "carbuncle"; if *malignant pustule*, use this term.
Apoplexy.— Specify the part affected.
Asthenia.— Too vague.
Asphyxia.— Specify the method.
Atrophy.— Too obscure: use specific term, if possible.
Colic.— Specify: rarely fatal.
Cardialgia.— Too vague.
Cephalitis.— Too vague.
Cerebral.— Too vague.
Childbirth.— Specify as follows: (1) Was the death due to some disease of pregnancy; (2) to some disease or accident incident to delivery; or (3) to some disease following delivery?
Coma.— Specify.
Convulsions.— State the cause, if possible.
Debility.— Too obscure.
Concussion of brain.— State whether accidental, suicidal, or homicidal.
Dentition.— Avoid this term, if possible to be more specific.
Dropsy.— Synonyme of anasarca: state source or cause.
Dystocia.— (See Childbirth.)
Eclampsia.— (See Convulsions.)
Exhaustion.— Too obscure.
Fever.— Specify what sort of fever.
Heart failure, paralysis of heart, cardiac exhaustion.— Avoid these terms if a more definite term can be given.
Hemorrhage.— Specify.
Inanition.— Too obscure.
Indigestion.— Too obscure.
Infantile.— Too obscure.
Malformation.— Specify as to form or part affected.
Miscarriage.— Specify.
Metria.— Obsolete term.
Marasmus.— Too obscure.
Natural causes.— Specify.
Nephria.— Obsolete term.
Old age.— This term should never be used when the exact nature of the cause of death can be stated.
Palsy, paralysis.— Symptoms; specify the cause: state whether due to cerebral hemorrhage, lead poisoning, traumatic or other causes.
Paramenia.— Obsolete term.
Premature birth.— Specify.
Sore throat.— Specify.
Shock.— Specify.
Syncope.— Too obscure.
Tumor.— State location and character.

Your committee further recommends that the foregoing list be printed, and that a copy be sent to each member of this Association, and to such experts as may be willing to revise it, with the request that they will amend and revise the same, and that the final revision be printed for general distribution.

With reference to the final clause of the vote of the Association, your committee believes that the present form of certificate of death is adequate to its present uses, provided that the blank form is enlarged, and a condensed list of the foregoing terms is printed upon the back in addition to the usual extract from the Statutes.

THE CHAIRMAN.— The next item on the programme is a paper on "Efficient Disinfection" by H. Lincoln Chase, M.D., of Brookline.

EFFICIENT DISINFECTION.

BY H. LINCOLN CHASE, M.D., BROOKLINE.

Sternberg defines "disinfection" as "the destruction of the infecting power of infectious material. The object of disinfection is to destroy infectious material of all kinds, wherever it may be found, and thus to restrict the prevalence of contagious diseases."

"The most satisfactory tests of disinfection are those which are made directly upon pure cultures of known pathogenic bacteria, and we have now very extensive experimental data relating to the practical germicide power of various physical and chemical agents tested in this way."

The kind of germ, the presence or absence of spores, the nature and quantity of associated material, the number of bacteria, the time of exposure to the germicide, the temperature at which the exposure is made, the degree of dilution of the disinfecting material, and, finally, the honesty and intelligence of the person intrusted with the work of disinfecting,— all these are most important factors in the problem of efficient disinfection.

Heat is undoubtedly the most potent agent available for the destruction of infectious material.

Experiments have demonstrated that those species that do not form spores are killed at a comparatively low temperature, and that the spores of even the anthrax bacillus and of the tubercle bacillus are quickly destroyed by the temperature of boiling water.

Cold, on the other hand, does not destroy bacteria. Prudden has shown that the typhoid bacillus still retains its vitality after being frozen for one hundred and three days; and Cadéac and Malet have shown that portions of

tuberculous lung, kept in a frozen condition for four months, still produced tuberculosis in guinea pigs.

Exposure to direct sunlight is fatal to many species of bacteria, and even diffused light has some germicide value.

An induction coil of electricity has decided germicide power.

Desiccation is sufficient to destroy some pathogenic bacteria, and very promptly. Bouillon cultures of the cholera spirillum, dried upon a culture glass, Koch states, will not grow after three hours. On the other hand, the tubercle bacillus and the bacillus of diphtheria resist the effect of desiccation for several months.

Oxidizing disinfectants, such as chlorine, iodine, iodine terchlorine, are numerous and useful, among which chlorinated lime is one of the best for practical purposes. It owes its germicide value to the amount of hypochlorite of lime it contains. Of the acids used as disinfectants, liquid sulphurous acid Sternberg found efficient for destruction of micrococci in two hours in as weak a solution as $\frac{1}{2000}$ by weight; and the great Japanese bacteriologist, Kitisato, found it would destroy the typhoid bacillus if only $\frac{1}{4}$ of 1 per cent., and the cholera bacillus if only $\frac{1}{100}$ of 1 per cent. This germicide, therefore, seems to deserve more attention as a practical disinfectant than most of us are giving to it.

Sulphurous acid in the dry form, however,—*i.e.*, sulphur dioxide anhydrous,—Sternberg and others find, has comparatively little disinfecting power, though in the presence of moisture it forms H_2SO_3,—*i.e.*, liquid sulphurous acid,—and this is a sufficient disinfectant in the absence of spores; but, in the presence of germs that multiply by spores, it has been demonstrated that it does not efficiently disinfect. Hence the recommendation of the Committee on Disinfectants of the American Public Health Association in 1887,—that fumigation with sulphurous acid gas alone, as commonly practised, cannot be relied upon for the disinfection of the sick-room and its contents, including bedding, furniture, infected clothing, etc.; but the committee recommended instead that all surfaces should be thoroughly washed with the standard solution of chloride of lime, diluted with three parts of water, or, best of all, a $\frac{1}{1000}$ solution of corrosive sublimate. As an additional precaution, it recommended at that time fumigation with sulphur,—a practice found liable, in our experience, to ruin articles moistened by the $\frac{1}{1000}$ corrosive sublimate solution. Behring, with two colleagues, published a work on disinfection about a year ago, in which sulphurous fumigation is only once mentioned,—that was in disinfection of ships,—and there only to condemn it.

The problem how to enforce our Public Statutes as to disinfection has received considerable attention by our local Board of Health, and I would like briefly to outline the method used here to secure it.

Upon the death, recovery, or removal of a person infected with small-pox, diphtheria, scarlet fever, etc., the Public Statutes require: "the householder shall disinfect to the satisfaction of the Board of Health such rooms and such articles therein as, in its opinion, have been subjected to infection; and any person neglecting or refusing to comply is liable to be fined $100."

The board gave notice in its circulars of orders, suggestions, etc., a few years ago, that final disinfection, to be satisfactory to the board, after diphtheria, scarlet fever, and small-pox, must be done by the board; and it appointed a person to do it under the supervision of the sanitary inspector and the agent of the board. It also announced that disinfection would be done free of expense, where the householder is unable to pay for it.

The directions for the men employed to disinfect are as follows, and were adopted Jan. 1, 1895: —

OFFICE OF THE BOARD OF HEALTH,
BROOKLINE, MASS., Jan. 1, 1895.

DIRECTIONS FOR DISINFECTION.

The men employed to disinfect shall be provided with skull-caps, overalls, and blouses of canvas or linen; and, after the work is done, these should be placed in bags, the latter moistened in a disinfectant. On leaving the room, the soles of the shoes should be wiped off, and the hands and face should then be washed in soap and water. On reaching home the overalls, blouses, and caps should be disinfected by boiling, baking, or by washing in a $\frac{1}{1000}$ solution of corrosive sublimate.

The rooms to be disinfected having been abandoned, the door should be locked, and no one permitted to enter for twelve to twenty-four hours previous to the arrival of the disinfectors, during which time the particles of dust and any infectious materials suspended in the air are given time to settle.

The liberation of steam in the rooms somewhat hastens the process of settling. The disinfectors should be provided with sheets and bags of various sizes moistened with corrosive sublimate solution ($\frac{1}{1000}$), sponges, scrubbing-brushes, mops, clean, coarse towels, etc., together with plenty of disinfecting solution (or the tablets of corrosive sublimate of known strength), and hot water. In some few cases the necessary articles for fumigation will have to be carried in addition to those above mentioned, also apparatus for making steam in the room, in order to make the fumigation more effective, if used.

Before beginning the work, and at intervals during it, the disinfectors should take the precaution to spray or gargle their throats with disinfectants; *e.g.*, boracic acid or sulphurous acid solution.

They should be vaccinated every five years, so as to be ready to disinfect after small-pox.

First, the furniture is covered with sheets moistened in corrosive sublimate solution, and the various articles to be removed are placed in the bags. The floor, window-sills, and all surfaces on which dust may have lodged should now be

mopped up or wiped with coarse towels moistened with a hot solution of corrosive sublimate ($\frac{1}{1000}$) wrung out at frequent intervals in a wooden or paper pail containing the solution.

The walls of the room are now to be wiped down with the solution ($\frac{1}{1000}$), if painted or covered with oiled or glazed paper, or even if of cheap or destructible paper, later to be removed. If the wall paper is very valuable, but liable to be damaged by even slight moisture, it can be rubbed down with fresh glutinous brown bread, fixed in a frame, and then dry wiped to remove the particles of bread.

The furniture and objects which have been placed in the moistened sheets and bags can now be removed from their wrappings.

The furniture is brought, piece by piece, to the centre of the room, and the sheets removed. Cheap mattresses and any other cheap article, if badly infected, must be burned.

Expensive mattresses or blankets, when infected, can be wrapped in sheets saturated with a ($\frac{1}{1000}$) solution of corrosive sublimate, and taken to a steam disinfecting or naphtha cleansing establishment. Slightly infected carpets, also mattresses, should be lightly and carefully sponged off with the sublimate solution ($\frac{1}{1000}$), and then be placed where they can dry rapidly.

Polished furniture can be wiped off with a sponge moistened with the same solution.

Woollen blankets can be soaked in a ($\frac{1}{2000}$) warm (not hot) solution of corrosive sublimate, in wooden or stone tubs, for twenty-four hours, and then washed out; but they are liable to shrink somewhat. All articles that can be boiled without injury should be boiled for an hour. Some few articles of clothing can be treated by baking, and a few by fumigation followed by prolonged airing out of doors, in the sunlight; but the other methods are superior, if practicable.

The floors, bedsteads, chests of drawers, windows, doors, wooden mattress, frames, etc., should be scrubbed or wiped off with hot disinfectant solution, ($\frac{1}{1000}$) corrosive sublimate. After disinfection is over, the rooms should be well aired for at least twenty-four hours.

If the above process for any reason is not practicable, 4 pounds of sulphur to the 1,000 cubic feet can be burned, after first warming and moistening the air in the room by useof steam or otherwise, remembering, however, that the colors of the paper are liable to be somewhat bleached, and metal objects will be corroded.

Where fumigation is necessary, it is never to be done while articles in the room are wet or where metallic surfaces are exposed; for damage is sure to result. Complicated gas fixtures should be dry wiped and removed from the room before fumigating. Fumigation is to be done only where other measures are not practicable. The room should be tightly closed, and exposed to the fumes for from twelve to twenty-four hours, never less than twelve. The rooms adjoining the sick room or rooms should be exposed to sunlight, and an abundance of fresh air admitted to them (the longer, the better) before they are reoccupied by children.

When questions not covered by these instructions arise, the disinfector will ask for further instructions from the agent of the board.

H. LINCOLN CHASE, M.D.,
Agent of the Board.

In preparing the above, the writer has followed the instructions given by Sternberg, Esmarch, S. W. Abbott, and Nuttall.

We have not yet worked out the entire problem of efficient disinfection; but we are all of us, I believe, relying less and less on sulphur fumigation, till recently a word to conjure with. In Brookline, except for our Board of Health ambulance, and for places infested with bed-bugs, we very seldom employ it. We are willing to endure the criticisms of the ignorant till such time as the cautions of Welch, Prudden, Sternberg, and other pathfinders in sanitary research, shall be heard and obeyed, and more reliable means of disinfection, however cheap and popular the old may be, are generally adopted.

THE CHAIRMAN.— Dr. Worcester, who was to discuss this paper, having been obliged to leave, I will call on Mr. William F. Morse, of New York City.

REMARKS OF WILLIAM F. MORSE, ESQ.

Mr. Chairman,— Upon the question upon methods of steam disinfection I propose, with your permission, to make a slight departure from the line of argument of the last speaker, and to present some notes upon a new apparatus for steam disinfection for the use of hospitals, public institutions, and municipalities, which has been lately examined and reported upon by eminent sanitarians in Great Britain.

A remark made more than a year ago by Dr. Abbott, secretary of the Massachusetts State Board of Health, to the effect that "this country was a long way behind European countries in the adoption of steam disinfection," has led to the examination of some of the apparatus in use on both sides of the water. The secretary of the Maine State Board of Health, in a little pamphlet reprinted from the report of the board of last year, entitled "Notes on Steam Disinfection," gives a short synopsis of several methods in use in Europe, contrasting the relative advantages of steam disinfection under high pressure with disinfection by steam not under pressure, but "flowing in a free current through the goods to be disinfected." I have been at some trouble to obtain reliable reports from the low pressure apparatus, and had a correspondence with the inventor and manufacturer of the one which has been longest in use, of which there are many examples in Northern Europe. This is the Reck disinfector made in Copenhagen.

The main principles of operation of this apparatus are the use of steam at 1½ pounds' pressure per square inch as against high pressure apparatus which requires a 20 pound pressure per square inch, the passage of the steam through the goods to be disinfected, and the condensation of the steam within the chamber by a shower of cold water without saturation of the goods.

The following description taken from the *Sanitary Record*, published in London, September issue, 1895, may be quoted as giving a clear idea of the invention in the shortest space: —

"His apparatus, then, is an unjacketed chamber. In it is a basket made of galvanized wire-work, covered with a coating of what may be called cotton felt. This basket is large enough to nearly fill the chamber, and is made and fitted so as to slide in and out with facility, at either end or at either side, its motion resembling that of a sledge. Bearing in mind that saturation tends to diminish the action of heat, the articles to be disinfected should be first thoroughly dried and in that state put into the basket. The basket is then pushed into the chamber through the entrance door, and shut in, the entrance and exit doors being both secured by bolts and screw-nuts that render the whole steam-tight.

"Steam being then requisite, it must have been previously provided. It may be derived from any engine-boiler without appreciably affecting its working power for driving or for other purposes, or a special boiler may be provided and made ready at a very small cost. Other incidental fittings are included with the apparatus.

"As, at the time of commencing operations, the interior of course contains a quantity of atmospheric air, provision is made for its exit by the opening of a pipe at the bottom corner; and immediately afterward steam is turned on through a pipe at the top. The first effect is for the steam to drive out the air at the exit, with as much promptitude as would be exhibited by a colony of rats on the entrance of a ferret. The forcing out of all the air is soon indicated by the issue from the exit of steam, rendered visible as before described.

"The exit is then closed; and the pressure of steam in the interior instantly operates, increasing it until it is equal to 1½ pounds to the inch, in addition to the atmospheric pressure of 14½ pounds, making in all 16 pounds, that being the maximum required or permitted. When that maximum is reached, a lever is automatically actuated by the pressure within, so as to shut off the steam all but enough to continue the pressure named, which is thus uniformly maintained for thirty-five minutes.

"During that time experimental observation demonstrates that the steam (slight as its pressure) thoroughly penetrates every part of the fabrics or articles under treatment, however thick, inducing a continuous heat equal to 222 degrees, — that is, 10 above boiling point,— which is amply proved to be so completely effective as in half an hour to kill anthrax spores (the most tenacious of life known), which are ordinarily capable of resisting and remaining alive, though subjected to a 5 per cent. solution of carbolic acid from four to six days. Such half-hour result has been obtained, though the spores were placed in the centre of a mattress rolled up in

blankets; and a registering thermometer, placed in like manner, indicates the stipulated heat on subsequent examination, thus showing what such a very slight pressure of steam is capable of doing.

"We have said that the chamber is not jacketed; but a little distance from the top there is fixed instead a curved sheet of metal, forming a cover for the basket in the manner of an umbrella. The prescribed time for disinfection being ended, the steam is shut off, the exit-pipe at the bottom opened, and a flow of cold water admitted at the top. The cold water, conducted by the cover to either side of the chamber, then rushes down and makes for the exit, the cotton felt before mentioned preventing the contents of the basket from being splashed. The interior heat is so intense in its effect that the water, though it proceeds with great velocity to the exit, runs thence steaming hot. Simultaneously, and in corresponding proportion, the steam is rapidly condensed, and tends to create a vacuum. This is anticipated by the provision of an automatic valve, which, as soon and as fast as the steam condenses, allows an equivalent quantity of air to enter, and so to secure the requisite epuilibrium, the air entering with an audible blowing noise, in evidence of the existence and purpose of the valve, until the air has completely replaced the steam.

"By that time the water at the exit runs cold, the flow of it is shut off, the exit door opened, the basket drawn out, the disinfected articles, with a barely perceptible tinge of damp upon them, are removed, and aired by warming arrangements for that purpose.

"We write after seeing the whole process through, and such is a description of the apparatus and the manner of using it, as recommended for adoption in most cases. To meet special requirement, the same principles are otherwise applied by a different mechanical arrangement that proceeds upon precisely the same theory, and secures corresponding results in their entirety. In whatever manner the principles are applied, the disinfecting chamber may be either circular, oval, or rectangular, with height enough to allow of the hanging of the articles of clothing therein, thus insuring that they run no risk of being creased by folding.

"The entire apparatus, in any shape or size desired, may be stationary or mounted upon wheels, so as to be readily portable, the latter arrangement including a boiler, so that the disinfecting process can be applied with great facility in different places at very short notice.

"Apart from its great efficiency, the primary recommendation of this apparatus is that the pressure of steam required is so slight. The expense of controlling such pressure is therefore very little, there is no necessity for the costly strength that is essential where a high pressure is adopted, and there can never be any chance of a dangerous catastrophe. The economy both of initiation and working is therefore very marked."

That there is great need for these disinfecting plants will be admitted by any one who will consider the question for a moment.

In Great Britain alone there are four hundred disinfecting plants in use in public institutions and municipalities. This is a proportion of about one to every hundred thousand persons. In Denmark there is a disinfecting plant for each ten thousand persons, and their use is being continuously extended. In the United States, with a population of more than sixty millions, I venture to say that, if the numbers were accurately estimated, there would not be more than fifty satisfactory disinfecting plants of all kinds found in use.

The correspondence, inquiries, and investigations now being actively pursued by health officials indicate great interest, even anxiety, to obtain the best systems consistent with the utmost economy.

The efficiency of the Reck disinfector has been verified by the report of a committee appointed by the city government of Copenhagen, by the report of the surgeon-in-chief of the Danish Royal Army, by the head of the medical staff of the Danish Navy, by the report of medical authorities of more than one hundred and fifty institutions and towns in Denmark, Sweden, and Norway which employ this apparatus, and by the report of Dr. Read of Stafford, England, who made a thorough test of the disinfector in England, assisted by a half-dozen medical officers of cities and towns.

There can be no doubt of the efficiency of the apparatus after the experiments, tests, and practical uses by all these gentlemen.

The question of relative cost to install a disinfecting apparatus depends mainly upon the expense for making the steam cylinder. A steam chamber which must carry a pressure of 40 to 50 pounds must be heavy and strong to resist the strain. The English disinfectors are universally double-jacketed and rectangular in shape. There are two chambers, one within the other, with a space of 2 inches between. These have to be supported by stay-bolts to resist the strain, which adds greatly to the expense of the construction. Steam disinfecting appliances now used in Boston are single cylinders, circular in form, and the introduction of the steam and heat is obtained by coils of steam-pipe at the top and bottom; but here the chamber must be able to withstand a pressure of 50 pounds per square inch. The low-pressure apparatus adopted by Mr. Reck does not require the use of heavy steel chambers, as these can be made very much lighter. There are no interior pipes to take up the room; the full area of the chamber can be utilized; the doors, car, tracks, and steam attachments are lighter and more simple than in the high pressure. All this is a saving of expense.

Where a boiler has to be used specially for the steam disinfector, there is a still greater economy, as it only requires a 4-horse power boiler with a pressure of 1½ pounds of steam to do the work which in a high

pressure apparatus would require a 25-horse power boiler with a minimum pressure of 20 pounds. The room occupied by each is about the same.

A comparison of the relative cost of a given size, 7 feet long, 3 feet in diameter, circular form, or 3 by 4 feet rectangular form, which would be suitable for a large hospital or for a town of ten thousand people, shows that, while in Denmark this would cost with the boiler about $350, in England it would cost about $1,000, and in the United States not far from $1,200; and, making due allowances for the increased cost of labor and material in this country, it seems probable that a low-pressure disinfecting plant could be installed at about one-half the cost of the high-pressure systems.

If this be true, then the advantage in point of economy of the low-pressure system is greatly superior to the other.

If the efficiency of the work done is as perfect as it is in the high-pressure methods, then there would appear to be a strong reason for the introduction of this more economical means as against the expensive ones now usually employed, and a powerful argument in strengthening the hands of the health officers when asking for appropriations to construct disinfecting apparatus, the necessity of which is admitted to be imperative. Cities and towns that annually destroy more than twice as much infected goods and articles as to defray the cost of a disinfecting plant would have no reason for objecting to the outlay for this purpose on the score of economy, and it would furnish the health officials with a weapon against the spread of a contagion which can be hardly equalled.

It can be brought into use in connection with the heating apparatus of any large building where steam is constantly employed, and can be operated without the necessity of a skilled engineer's constant attention, as the work can be done by any one in the employ of the Health Department.

It is probable that within a very short time a low-pressure plant after the designs of Mr. Reck will be in operation in this country; and it will be interesting to note its usefulness and efficiency as compared with the more elaborate, expensive systems of high pressure.

THE CHAIRMAN.— We shall be glad to hear from Dr. Peters.

THE DISINFECTION OF FARM BUILDINGS, STABLES, AND SIMILAR PLACES.

BY AUSTIN PETERS, M.R.C.V.S.

Mr. Chairman and Gentlemen,— I have been invited to make a few remarks in concluding the subject of efficient disinfection from a veterinary standpoint. Boards of health, in the performance of their official functions, may be called upon to disinfect stables where cases of glanders have occurred among horses, barns where tuberculous cattle have been kept, piggeries after outbreaks of infectious swine disorders, or these buildings may require disinfecting after outbreaks of other diseases not mentioned above. The means and methods of disinfecting stables, barns, and similar buildings, may vary with the appliances conveniently available for accomplishing the desired object, and also depend much upon the construction of the buildings, their finish, and the value and condition of the materials of which they are made. In some cases the question of the disinfection of harnesses, halters, blankets, curry-combs, brushes, pails, and various utensils, has to be considered; and it is possible that under some circumstances railroad cars would be required to come in for a share of purification. Then again, in some instances, it would be necessary to destroy litter and manure; and in other cases earth might have to be carted away and replaced with fresh material.

There is an old Scotch saying, that "there are other ways of killing a dog besides choking him with butter"; and I think it holds good in a consideration of this topic. It is not so much what we use, or what steps we take to accomplish a given result, as it is the care and thoroughness with which the work is done. The premises to be disinfected should first be looked over, and then the best means for cleaning them up can be decided upon.

There are two great factors that, it must be borne in mind, are valuable, not only for purification, but for preserving health as well. These are fresh air (oxygen) and sunlight. Their presence is necessary in carrying out our work, and their continuance should be insisted upon in all stables for the maintenance of health.

Fire is another very effective destroyer of germs; and a certain way of disinfecting an inflammable structure is to touch a match to it, and let it blaze. In this way we are sure of the admittance of the fresh air and sunshine already advocated, after completing the first steps of the disinfecting process. This method of procedure is, as a rule, too expensive to carry out in its entirety; but it can often be done advantageously to a limited extent

by making bonfires of old mangers, worn-out floor boards, straw, rubbish, possibly worn-out halters, blankets, harness, etc., and in some diseases by the cremation of the carcasses of deceased animals.

Steam is another valuable agent for killing bacteria, and in many farm barns there may be a boiler connected with an engine or for cooking feed. Here a hose (an ordinary ½-inch rubber hose will do) can be connected with the boiler; and then a man may use it, putting a pair of thick woollen mittens on to protect his hands, and bringing the live steam in close contact with every surface or nook and cranny to be disinfected. The planks should be steamed until they fairly squirm.

Whitewash is another valuable agent for cleansing and purifying stables and farm buildings, especially if put on when freshly made, hot, if possible. It may be applied with a brush or it can be very thoroughly and rapidly put on by means of a garden force pump. For this purpose it must be mixed thin enough to readily go through the pump.

Three years ago this winter I was engaged a portion of the time in working for the New York State Board of Health in investigating bovine tuberculosis in Westchester and Orange Counties. It was in these localities that contagious pleuro-pneumonia had been especially prevalent a few years before; and I could not fail to be impressed by how thoroughly the United States Department of Agriculture had stamped it out, and how effectively the farm barns had been disinfected. In thinking over what I wished to say this afternoon the other day, it occurred to me to write to Dr. Salmon, chief of the Bureau of Animal Industry, asking about it; and I received the following reply: —

UNITED STATES DEPARTMENT OF AGRICULTURE,
BUREAU OF ANIMAL INDUSTRY.
WASHINGTON, D.C., Oct. 1, 1895.

DR. AUSTIN PETERS, 40 Water Street, Room 45, Boston, Mass.

Dear Doctor,— Referring to your letter of the 28th ult., our disinfection in the pleuro-pneumonia work was thorough because we had a special disinfecting corps, which gave their whole attention to that subject. The buildings were thoroughly prepared for disinfection by removing rotten wood and all obstructions. The floors and walls were then washed with a bichloride of mercury solution; and, finally, the whole interior of the building was covered with a whitewash made of lime, containing about half a pound of fresh chloride of lime to the gallon. This was put on with a force pump and hose, the pump being a large and powerful one, and requiring three or four men to work it. The secret of our success was, therefore, good material and its thorough application.

Very respectfully,

D. E. SALMON,
Chief of Bureau.

This mixture of chloride of lime with whitewash is an excellent one.

Corrosive sublimate is a valuable germicide, but it must also be remembered that it is a dangerous poison. I have had it used extensively in disinfecting cow barns, and never with any bad effects upon the cattle, that I know of. When it is used to wash out mangers and the woodwork around the heads of the creatures, where they can lick the walls or partitions, these places should always be carefully washed off afterward with clean water, and wiped dry, before returning the animals to their stalls.

I usually have the floors of a cow stable scraped clean, and then washed with a corrosive sublimate solution of 1 to 1,000, the walls, mangers, etc., are gone over with a whitewash brush and a corrosive sublimate mixture. Here 1 to 2,000 is strong enough; and, after it is dry, whitewash is put on over it. If steam is available, it can be used in conjunction with the whitewash and bichloride.

In fancy barns, with hard-wood floors and matched sheathing, often shellacked or varnished over, the corrosive sublimate wash alone can be used, afterward washed off; and, if the varnish is injured, it can then be done over.

Gaseous disinfectants penetrate into every crevice. Therefore, if effective germicides, their action is very thorough; but at the present time it is considered doubtful if sulphurous acid vapor is a very certain destroyer of microbic life. A better vapor is chlorine, made by mixing a small amount of black oxide of manganese with rock salt in a suitable receptacle, and pouring over it sulphuric acid with a little water added. Where a gas is used, the doors, windows, and ventilators must of course be tightly closed. In outbreaks of infectious swine diseases, or in septic pneumonia in horse stables, it may be necessary, in order to make disinfection thorough, to cart away earth from pens or from under piggery or stable floors, and replace with clean material from a neighboring sand or gravel bank.

THE CHAIRMAN.— Shall we hear from Dr. Osgood on this subject?

DR. F. H. OSGOOD.— Mr. Chairman, I do not think I can add very much to what our friend, Dr. Peters, has said on this line; and I won't occupy your time.

THE CHAIRMAN.— Perhaps Dr. Chapin, of Providence, will tell us something about disinfection by formalin, discussed recently by Dr. Kinyon.

REMARKS OF DR. C. V. CHAPIN.

Mr. President and Gentlemen,— I can only repeat what I heard Dr. Kinyon say at the meeting of the American Public Health Association in Denver. He suggested the use of formalin. This is a 40 per cent. solution of formaldehyde; and formaldehyde is certainly a very powerful gaseous disinfectant, which may be used for the disinfection of rooms. I do not know that he had ever actually tried it in a room as we health officers have used it in medical disinfection, but he has used it in a large tank and in small receptacles. He found it extremely efficient, and found it would penetrate through many thicknesses of blankets, and in a very short time would kill the ordinary bacteria. He suggested that, if used in a room, two or three pounds of formalin should be placed in a vessel, and that put in another vessel of warm water, and the room closed up and left four or five hours. Then it would be necessary to air it for twelve hours, and from his experience he thought it would work well. Yesterday I made that experiment, but have not yet learned the result.

This formalin, as you know perhaps, is quite expensive. It costs in large quantities, a hundred pounds, eighty cents a pound; but the formaldehyde can be prepared by burning methyl alcohol against a platinum cone. Dr. Kinyon said that an apparatus had been devised for that purpose. I have not yet been able to get hold of one, but it certainly would not be very difficult to devise something of that kind. It remains for practical experience to determine whether this method is effectual, one that can be used in the ordinary rooms of dwellings. We all know that such a room is not like a tight tank used for steam disinfection. We know that a gaseous disinfectant must be used in a pretty tight room, in order to give the desired results.

THE CHAIRMAN.— I was induced to ask Dr. Chapin to give you this item because of the very strong impression which I received in a talk with Dr. Kinyon, and the hope that this gas may serve in place of our present method of gaseous disinfection. There is one objection which Dr. Kinyon mentioned; and that was its extremely irritating effect, it being quite as bad, I think, as chlorine gas for those who use it.

Are there any further remarks to be made upon this paper? If not, we will pass at once to the paper on "The Best Systems of Garbage Disposal for Large and Small Municipalities," by Dr. Field.

THE BEST METHODS OF GARBAGE DISPOSAL FOR LARGE AND SMALL CITIES.

BY JAMES B. FIELD, M.D., CHAIRMAN OF THE LOWELL BOARD OF HEALTH.

I regret that I cannot answer the question implied in the title of this paper, by informing you as to what is the best method of garbage disposal. To do so, it would be necessary to investigate the merits of thirteen or fourteen different garbage plants in nearly fifty different cities in this country, as well as to be posted upon the results obtained abroad. The difficulties of such an investigation would be enhanced by the fact that in many instances it is impossible to obtain accurate, unprejudiced figures as to the expense of disposing of the garbage.

I cannot speak with any degree of authority on the subject, except as regarding the system used in Lowell and the lessons we have learned from it.

Five years ago I had the honor of addressing this Association upon the same subject. There is not now such need as there was then of emphasizing the necessity of destroying garbage. We are all agreed that the swill and market refuse of a city should not be fed to swine or to cows. Indeed, the law of this State prevents us from feeding this material to cows. The act of 1889, introduced by the Lowell Board of Health, specifies that the garbage collected by a city or town shall not be fed to milch cows. The act of 1895 puts another restriction upon cities of over 30,000 population, by providing that the swill collected shall not be fed to any food animal except swine, thus extending the law in larger cities from milch cows to all cattle. What new dangerous characteristics garbage assumes when a city reaches 30,000 inhabitants can, I suppose, be only stated by our legislators.

We are deterred from feeding this material to hogs by fear of producing trichinosis, as was proved by Professor Mark's investigation. Even if the danger from this cause is exaggerated, the nuisance caused by a municipal piggery cannot be minimized, as the health authorities of Worcester and an adjoining town will tell us of the piggery maintained by the pauper department of Worcester.

Of all the methods of garbage disposal there is none that would result in such a saving for a city as to have each householder destroy his own table refuse. This would save not only the expense of disposal, but also the greater expense of collecting the garbage. For a long time such a plan has been advocated by the chairman of the Boston Board of Health. Some years ago there were a few stoves and ranges constructed with an

attachment at one side for the combustion of house offal. Nothing practical in this line had been done, until recently an invention, known as the Household Garbage Carbonizer, has been put on the market. In this appliance the garbage is inserted into the stove, is dried and carbonized, without interfering with the regular work of the stove. The next morning the charred residue may be used as a kindling for the morning fire. If the Household Carbonizer needed any recommendation beyond its own simplicity and merits, it might be stated that it is indorsed by two members of this Association, gentlemen who are chary even of recommending a good thing, and whose recommendation, when given, must carry considerable weight. I refer to the chairman of the Boston Board of Health and the agent of the Brookline Board. Furthermore, the Household Carbonizer is put upon the market by another member of this Association, well versed in the subject of garbage disposal, and not likely to advocate an article that did not possess intrinsic merit. An appliance like this, which would, if in general use, do away with swill carts and the expense of collection and destruction of the offal, ought to receive our most serious consideration. Unfortunately, however, there are two or three obstacles to its general use. One is that in summer, when there is more garbage, small families often use the oil or gas stove. Another objection is that many people would not care to pay the small cost of a carbonizer as long as the city takes away the garbage free of charge. Still another trouble would come with part of our foreign population, too ignorant to use the simplest of appliances. For these reasons it will be necessary in most cities to supplement the use of the Household Carbonizer by some system of municipal disposal of swill, that will also dispose of the market refuse. We ought, however, to encourage the use of the Household Carbonizer as much as possible. In an ideal residential community such as we are now visiting [Brookline], where every householder has the best interests of the town at heart, the Household Carbonizer will meet with its greatest success.

Among the methods of municipal garbage disposal, the one that appeals to us at first thought is the utilization or reduction method, where the valuable constituents of the garbage are extracted and utilized. We cannot fail to be attracted to any method that thus produces something valuable from waste material. In this case, however, the cost of producing may exceed the value of the product.

One of the best known of these methods is the Merz process. Here the garbage is first steamed in tightly closed iron tanks, after which the water is squeezed out from the garbage in presses. Next it is dried in steam-jacketed iron cylinders. Finally, the material, now containing less than 8 per cent. of moisture, is treated with benzine or naphtha to extract the fat. The remaining tankage, containing a small amount of phosphoric acid and ammonia, is manufactured into fertilizer.

Six or seven years ago I recommended this process to the city of Lowell, having been led to believe that the revenue from the sale of grease and fertilizer would more than pay the cost of carrying on the process. In Buffalo the Merz people offered to treat the garbage for nothing, but before long they were so much out of pocket that the plant was abandoned. Finally, the city of Buffalo decided to pay a bonus for the destruction of its garbage; and so the Merz people improved their plant, and started up again. They now receive a bonus of $35,000 a year. Their plant is located just outside the city line. In Milwaukee the Merz system is located fourteen miles north of the city, and a bonus of some $24,000 is paid for the destruction of the garbage. In Detroit the Merz people have a plant twenty miles from the city, and collect and dispose of the garbage for $63,000 a year. In St. Louis the Merz system is also used, their plant costing about $280,000, and apparently giving satisfaction. This plant is in a sparsely settled part of the city. It treats about 180 tons of garbage a day, is supplied with an elaborate system of ventilation, and is the best reduction plant now in use. We have no data as to the cost to the city per ton of garbage destroyed by this process.

Another well-known reduction process about which we heard at our Lynn meeting three years ago is the Simonin. This was formerly in use in Providence; and our fellow-member, the Superintendent of Health of that city, can describe it to you much more satisfactorily than I can. The Providence plant was abandoned nearly a year and a half ago, because of the nuisance caused by naphtha and swill vapor escaping from leaky condensing pipes. In Cincinnati, or, rather, seven miles down the river, is a Simonin plant which destroys the garbage of that city. There is a contract for ten years, at an annual cost to the city of from $15,000 to $20,000. It is understood that here a trouble exists similar to that in the Providence plant. In New Orleans, however, the Simonin process, with improved condensers and other new appliances, is very satisfactory from a sanitary point of view.

Still another form of reduction apparatus is that which for a short time was in operation in Boston by the New England Construction Company. By this process the garbage is treated by steam under pressure, thus driving off the moisture and extracting the grease. The dried residue is ground up into fertilizer. This process was formerly in use in Washington, where most varied reports were given as to its success. Many complaints were made as to the unbearable nuisance caused by the plant in that city. It was alleged, however, that some of these complaints were started by a disappointed garbage collector, who formerly had the material to feed to his hogs. Be that as it may, the plant was burned down a few years ago, and never rebuilt. A similar process, known as the Arnold, has recently been put in use in Philadelphia, and is not free from objectionable odor. As to

the plant in Boston, we all know that its operations were considered by the courts to cause a nuisance, and that the plant had to be abandoned. The same company had been endeavoring to locate in Lowell a plant in which, if a long-term contract was assured, they would dispose of our garbage at twenty-five cents a ton,— a price far lower than any other method seemed to offer. A decision as to this proposition was deferred until the Boston plant was put in operation. Upon the condemnation of the plant there, we decided that whatever financial merits this process might possess, it certainly could not be located near any dwellings. Accordingly, the company made us a second proposition,— to convey the garbage in tightly closed boxes, by railroad, to Tewksbury, and there to dispose of it by their process, at seventy-five cents per ton. With the lowest figures from our cremator reaching eighty-one cents, it did not seem wise to sign a contract for a term of years at seventy-five cents. For this and other reasons the project was abandoned.

To illustrate the claims made by parties who have new systems of destroying garbage to sell, it will be necessary to mention a fourth kind of reduction apparatus. In this process, which shall be nameless, certain chemical agents are added to the garbage. The finished product is said to be rich in ammonia, phosphoric acid, potash, and grease. After deducting all expenses, there is a net profit of $4 on each ton of green garbage. A plant for the treatment of thirty tons a day costs under $23,000. If this amount is treated daily, the revenue in one year is over $37,000,— an income of only 160 per cent. on the investment. With such a profit it seems rather strange that the company sells a plant outright instead of offering to treat the garbage for nothing. No city has yet adopted this plan, which by its own revenue would pay for the collection of garbage as well as its destruction.

While the agent of every garbage appliance is undoubtedly honest and thoroughly believes his own statements, we should nevertheless seek for corroborative evidence from unprejudiced sources.

In three or four other cities contracts have been signed for reduction plants, in some cases over a year and a half ago. There has, however, been considerable delay or trouble of one kind or another; for the buildings have yet to be erected.

It is understood that the officials having in charge the garbage disposal of New York City were, until recently, in favor of some reduction or utilization process. Colonel Waring, however, is reported as saying that the reduction processes are in such an unsettled condition, and improvements are so likely to be made, that at present he would not sign a contract for even as short a time as five years.

It will be noticed that in many instances these various reduction plants

are located several miles outside the city. This, of course, increases the expense of the haul, but is nevertheless advisable. Any rendering system, even with the best construction and with skilled supervision of its workings, is a nuisance, unless provided with efficient means of mechanical ventilation.

The initial cost of the common reduction systems renders them out of the question for small cities. Again, a system which has a large marketable product to dispose of opens up inducements for speculation; and, in the prospect of financial gain, the sanitary reasons for which the system was adopted may be overlooked. In any city where the health department is out of politics, the system employed should therefore be operated by this department rather than by a stock company.

The last form of garbage disposal to consider is its destruction by cremation. For several years garbage furnaces have been in use abroad; and within the last few years their use has rapidly increased in this country, especially in the South and West, until now fifty-five or fifty-six garbage furnaces are in use,—a striking contrast to the small number of reduction plants.

Thirty-five of these furnaces are the Engle furnaces, used in twenty-five different cities, among them being Des Moines, Ia.; Ogden, Utah; Butte City, Mont.; Findlay and Columbus, Ohio; Birmingham, Ala.; Jacksonville, Fla.; Tampa and St. Augustine, Fla.; Savannah, Ga.; Richmond and Norfolk, Va.; Panama, Coney Island, and Lowell. As it is with a furnace of this pattern that I am most familiar (that is, the Engle furnace at Lowell), I will speak of it more at length.

With the construction of this furnace many of you are already familiar. The swill teams, driving into a covered enclosure on top of the furnace, dump the garbage directly into a large garbage chamber with grate bars and linings of heavy fire clay. At each end of this garbage chamber is a fire-box. The flames from the fire nearest the stack pass over the garbage, igniting it and driving the smoke and gases across the second fire, where they are consumed. The flame from this second fire is drawn by a strong draught underneath the garbage grates, intensely heating the garbage from below. This flame passes out through the stack, with but little color and a scarcely perceptible odor. From doors on the side the garbage is frequently stoked, and from a lower set of doors the ashes are raked out.

The furnace in Lowell, known as an extra No. 4, was erected in the fall of 1892, at a cost of $7,500. It is 42 feet long, 9½ feet wide, and 12½ feet high, outside measurement. The stack is 30 feet of brick and 60 feet of iron.

As the cost of burning was at first unsatisfactory, a temporary plant for burning by oil was introduced. This may have reduced the cost a trifle,

and undoubtedly would have more, had there been a permanent oil tank, so that oil could have been bought by the car instead of by the barrel. The only real complaint from using the cremator arose from the smell of the oil, due possibly to the temporary methods of its storage. There was also some danger to adjoining buildings from sparks, caused by the strong draft from the oil blower. The use of oil was finally abandoned, although in cities where oil is cheap it has been advantageously substituted for coal.

For the past three years we have kept accurate records of the weight of garbage cremated and the amount of coal necessary to consume it. Each week a statement is prepared, showing the amount of garbage consumed and the cost in coal and labor to effect its consumption. The health department of Lowell has no garbage furnaces to sell, and is not in league with the promoters of any system of garbage disposal. If other cities only gave as full and unbiassed figures as to the cost of treating their garbage, it would do much toward settling the vexed problem of what is the best system to use.

At Lowell in 1893 the most expensive week's burning was at the very high rate of $2.75 per ton. This, however, was the first week in which a full account was kept. Excluding this, the most expensive burning for a full week was at the rate of $1.94 a ton in 1893, $1.53 in 1894, and $1.31 in 1895. The least expensive week's burning in 1893 was at the rate of $1.15 per ton, in 1894 $1.02 per ton, and in 1895 81 cents per ton, thus reducing our lowest cost of combustion 34 cents a ton in two years.

To take, however, the least expensive week may not seem a fair comparison. The period from April 1 to October 1 can be compared for each year. For these six months in 1893 the average cost for fuel and labor for burning a ton of garbage was $1.57, in 1894 $1.17, and in 1895 99 cents,— a reduction of 56 cents in two years. About the middle of last July a change of firemen was made at the Lowell cremator. For the eleven weeks succeeding this change the cost of burning garbage has not averaged over 84 cents per ton.

Below is an itemized account of the least expensive week, August 26 to 31 inclusive, 1895 :—

Material burned.		*Expense.*	
Swill	167,742 lbs.	8 tons soft coal at $4.30	$34.40
Market refuse	31,430 lbs.	4 tons nut coal at $4.65	18 60
9 mattresses		1 man 7 days at $2.25	15.75
5 dogs		1 man 6 days at $2.00	12.00
6 cats			$80.75
8 bundles of rags			

100 tons at $0.81 per ton.

As a rule, the larger the amount of swill, the cheaper the cost per ton. With improved methods of firing and more systematic stoking of the garbage, we have steadily reduced the cost of combustion. Probably the cost will eventually go somewhat lower, but there will not be any large decrease.

The ashes resulting from the combustion of Lowell garbage have frequently been analyzed at the State Agricultural College and elsewhere. The analyses vary greatly, according to whether the ashes are kept under cover, free from moisture, or whether they are exposed to rain. There is also a difference between screened ashes and coarse ashes containing larger pieces of bone. To a certain extent summer ashes appear to be poorer than those of the spring or fall.

The largest amount of potassium oxide per 100 parts contained in a specimen of the ashes was 8.83. The largest amount of phosphoric acid was 32.36. In average specimens of ashes kept under cover there should be about 5 per cent. of potassium oxide and 16 per cent. of phosphoric acid. The phosphoric acid is in combination, mostly with lime.

Judging by the price paid for Canada wood ashes and material of a similar nature, the swill ashes ought to sell for from $8 to $10 a ton. At least 5 per cent. of the garbage comes out as ash, and this therefore would reduce the cost of combustion about 40 cents a ton. Fertilizer manufacturers, however, seem loath to experiment with new materials, and as yet we have sold only about 60 tons of ashes. We hope eventually to obtain a steady market for the ashes, but at present a revenue from this source should not be relied on.

When we say that it has never cost us under 80 cents a ton to burn our garbage, we do not mean that that is the lowest price at which we could burn garbage. With larger amounts of garbage, more perfect methods of drainage, and a wider furnace, exposing more area to the flames, there would be a much lessened expense of combustion.

Lowell has to pay high wages for labor, and more for fuel than almost any other Massachusetts city. Whether coal is brought by all rail or partly by water, the freight rates are high. Seaboard cities or those situated nearer the coal mines will make a better showing than does Lowell. In other cities using the Engle cremator, the cost of operating is much less than with us. Especially good results are obtained in the South, where fuel and labor are cheap. In Savannah, where pine wood is used as a fuel, a sworn statement of the cost of fuel and labor for four summer months gives a rate of 12.3 cents per cubic yard. If a cubic yard of swill weighs two-thirds of a ton, as it does in this locality, this would give the cost as 18.5 cents a ton. If our Lowell furnace could obtain similar fuel and labor, the cost would approach these figures.

The fact that there are in this country more Engle furnaces in use than all other kinds combined would seem to show that this is the best furnace. Whether this view is correct or not has not been determined. The sole reason for giving the Engle furnace prominence in this paper is because I am better acquainted with its workings. Theoretically there is no reason why other and newer types of furnace should not be an improvement upon the Engle. The utilization of heat that now goes up the chimney, for drying garbage before its cremation, and the exposing of a greater area of garbage to the flame ought to reduce the cost. Doubtless other furnaces may run more economically than the Engle, but there is no satisfactory proof that they do. They all fight shy of figures such as are given in Lowell. A furnace manufacturer's statement of a week's run with selected garbage is a very different thing from the statement issued by a Board of Health, giving every week's run, good and bad.

The Brown furnace is somewhat like the Engle in construction, except that the secondary fire is absent. The furnace is surrounded by a water jacket, and has iron grate bars of inverted V shape. Their furnace at Wilmington, Del., has done excellent work. A spray of oil is used as a fuel. I believe the expense is less than with our furnace at Lowell; but, as no such detailed statements are obtainable there, positive figures cannot be given. From statements made by the Wilmington Board of Health to the Newton (Mass.) Board of Health, an engineer and a laborer can destroy about twenty-seven tons of garbage daily by the use of 240 gallons of oil and $\frac{1}{4}$ ton of coal. This would mean about 53 cents per ton in Lowell. Over twice as much garbage is destroyed in Wilmington as in Lowell, which would also make a difference in the cost of destroying it. Moreover, the Brown furnace costs more to build than does an Engle furnace. There is also a Brown furnace at Troy, N.Y.

The Rider Garbage Furnace has been in operation in Pittsburg and in Allegheny City for six or seven years. The health authorities of those cities speak most enthusiastically of this furnace. It is a solid-hearth furnace, with two connecting dome-shaped chambers, into the top of which garbage is introduced, forming a cone-shaped pile, thus exposing great area of surface to the heat of the furnace, which is reflected downward from the dome-like top. The expense is estimated to be under 25 cents per ton; but these are manufacturer's figures, and no detailed report of the work of a furnace for a long period is given. Natural gas is used at Pittsburg, and slack coal at Allegheny. The cost of fuel would be much higher in New England, but an exact comparison is impossible.

The Dixon furnace uses three fires, one above and one beneath the garbage grates, and a third fire of coke situated in the flues, so as to consume all vapors which may arise from the burning garbage. This furnace

is in use at Atlanta, Ga., Salt Lake City, Camden, N.J., and at McKeesport, Pa. One is also being constructed at Fort Wayne, Ind. The report of the health officer of Washington, D.C., on the Atlanta furnace, commends it from a sanitary point of view, but spoke of the liability of trouble in other cities from the free water, which in Atlanta is soaked up by the dry rubbish collected with the swill. The McKeesport furnace was erected last year at a cost of a little over $8,000. It consumes night soil as well as refuse. Coal dust is used as a fuel. The furnace is reported as highly satisfactory both from a sanitary and economic point of view; but no reliable estimate as to the cost of operating can be made, as the material destroyed is not weighed, but is measured as one-horse loads, two-horse loads, barrels, and tanks.

The M. V. Smith Garbage Crematory, by means of Siemens's regenerators of checker-work fire-brick, stores up the heat that would otherwise go up the chimney. By a reversal of drafts the heat warms the fresh air that is used to support combustion. In each furnace there are two combustion chambers, so that the garbage burning in one chamber furnishes the heat to dry the greener garbage in the other chamber. When the garbage in the first chamber is fully incinerated, fresh garbage is supplied to it, and the current of fire is reversed. The hearth is solid, so that the garbage burns only on top. The plant is elaborate and expensive, combining, if necessary, several furnaces in one crematory. The furnaces at Wheeling, W. Va., and Muncie, Ind., use natural gas as a fuel, and destroy night soil as well as garbage. The furnaces at Atlantic City, N.J., and at Philadelphia, have to generate their own gas for fuel. The only complaint made against this furnace by the Washington authorities is that of water leaking from the lower doors. I have no data as to the cost of operating the Smith furnace.

The Mackay furnace at Yonkers, N.Y., is like the Engle in having a fire at each end. Its distinctive feature is two garbage grates, one above the other. The garbage, after a partial drying on the upper grate, passes through the revolving grate bars to the lower grate, where its combustion is completed.

The Vivarttus furnace at Philadelphia and at Scranton, Pa., provides for the drying of garbage before its combustion by placing it in separate chambers, from which it slowly passes to the combustion chamber. The Newton board's report condemns the Philadelphia furnace of this pattern as causing a very offensive odor, and not completely burning the garbage.

The Thackeray incinerator at Montreal is patterned after the English type of destructors. There are several pairs of large furnaces or cells, between which are smaller and more intensely heated cells for the combustion of more refractory materials. As with many other furnaces, there is a

fume cremator in the chimney. The waste heat is utilized by a boiler placed in the stack. The steam from this boiler runs a fan for forcing heated air through the cells. While the expense of operating this furnace is very low for large amounts of garbage, yet no analyzed details as to exact cost of labor and fuel are at hand. The Newton Massachusetts Board of Health has recently recommended the purchase of a Thackeray incinerator for $17,000, and intends to use it for the destruction of night soil as well as garbage and other municipal wastes.

The Brownlee furnace, in operation at Gainesville, Tex., at Terre Haute, Ind., and at New Brighton, Staten Island, is not unlike the Dixon furnace in principle. There is also a Johnson furnace at Chicago, and an oil burning furnace at Los Angeles. As yet there are not sufficient data to show that the newer furnaces have made much improvement over the older examples of the Engle and Brown furnaces.

The only way to obtain a satisfactory solution of the problem as how best to dispose of our swill is to make a thorough personal investigation of all the methods now in use.

Such an investigation, you will be glad to know, has been begun by Francis C. Green, of New York. Mr. Green has visited different cities, armed with an exhaustive set of questions concerning the collection and disposal of all waste materials. He is endeavoring to obtain information at first hand, and is supplementing it by personal inspection of the various systems. This investigation is under the direction of Mr. Rudolph Hering, the well-known civil engineer. Mr. Hering is chairman of the committee on disposal of garbage of the American Public Health Association. When his final report is made, it will be a most valuable and authoritative communication.

In the mean time the few conclusions that I can draw from limited personal observation and inquiry are as follows: That reduction systems, even if well located, properly constructed, and properly managed, can at present offer no marked improvement over crematories.

That at present cremation is the best solution of the problem for the average New England city.

That the kind of cremator to be selected should have been in active operation for at least a year in some city where it has caused no nuisance.

That trustworthy figures should be obtained as to the average cost in fuel and labor to burn a ton of garbage, and that the price of fuel and labor should be known.

That that crematory should be selected which, considering the original cost, will do the city's work most efficiently and economically.

That it should be owned and operated by the city.

That the cremator now in use in Lowell is a vast improvement over the methods employed in all other New England cities.

THE CHAIRMAN.— I will call upon Dr. Theobald Smith for some remarks upon this paper.

REMARKS OF DR. THEOBALD SMITH.

Mr. President and Members of the Association,— Most of our efforts in sanitation are directed to cities and large centres of population; and it seems to me that comparatively little is done for the smaller and poorer communities of the country, because the great pressure comes from the large cities and leaves the sanitarian little time to devote to strictly rural problems. Some time ago, in talking with Secretary Morton of the Department of Agriculture, I suggested to him that his department would be a good place for a division of rural hygiene, which could give its whole attention to the publication of educational literature having for its object the elevation of the sanitary condition of the country districts.

When I accepted the invitation to speak, I realized that I had nothing practical to say on the subject; but it seemed to me after a little reflection that it might be worth while to say something concerning the relation of garbage in the smaller towns and villages to animal diseases, especially as the garbage is still used extensively as food for animals. Of course, I am leaving aside entirely the question as to its food value, which is something for agriculturists to consider; but it seems to me that it might be worth while to consider how far garbage is actually dangerous as found in country villages and wherein the danger lies.

Our boards of health have in charge the control of infectious animal diseases, and, if they can show to our rural population that the garbage is to a certain degree dangerous to animal life, it will be much less difficult to convince them of its possible dangers to human health. In regard to the dangers of garbage from private households, there is, of course, the possibility of poisonous substances being thrown into the garbage, and afterward fed to animals, with serious results. Pointed metallic bodies may be carelessly thrown into it. I recall in this connection a herd of cattle in the District of Columbia which were examined by the Agricultural Department for tuberculosis. There were thirteen, I think, in this herd; and I made the autopsies myself, studying then tuberculosis almost exclusively, and I found in eleven extensive lesions between the second stomach and the liver, due to pointed bodies which these animals had swallowed. Not only had they produced local inflammations and abscesses, but they had in a few cases caused abscesses in the lungs and extensive pleuritis. Inquiry was made; and it was found that these animals had access to rubbish heaps, which, I think, may come under the designation of garbage in this discussion. Most of these pointed objects were hair-pins,

and this was explained by the fact that it was a girls' school from which the rubbish was collected.

This is only an instance of the possible dangers of garbage in an incidental way. The greatest dangers lie elsewhere. Garbage is collected from the larger centres of population; and the more varied and extensive the collection, of course, the more likely it is that disease germs are present which are dangerous to animal life. This will perhaps apply more to swine than to other domestic animals. I do not know what the conditions are in this State in that respect; but it is a fact that a great many outbreaks of swine disease, the loss of which bears heavily upon the farmer, are due to the swine being fed upon the swill of hotels and cities near by. I may be permitted to recall an extensive outbreak in New Jersey, where the swill from the hotels of Atlantic City was fed to swine. In making autopsies of these cases, I found it very interesting to note the great variety of lesions which these animals exhibited,—lesions which could not be classed under any one disease, but which belonged to several diseases. A number of disease germs had been brought together in the garbage fed to this herd, and transferred from one animal to another by direct infection. This was proven by the isolation of three distinct disease germs from this herd.

Much has been said concerning the danger of fermenting and decomposing garbage. Garbage in this condition contains a large number of bacteria, but they are not necessarily specific disease germs. I think the dangers arising from offal in this condition overestimated. Thus we have in milk an immense number of bacteria which are introduced into butter and cheese. But they are with rare exceptions harmless species. The same may be said in regard to garbage. As a matter of fact, the multiplication of saprophytic bacteria may check the multiplication of the dangerous species accidentally present.

E. Klein, of London, maintained recently that diphtheria bacilli injected into cows appeared in the milk. If this were true, swill feeding might prove dangerous by introducing into the body of the cow disease germs which would be excreted by the udder. Klein's results have been discredited by Abbott, and I think it is safe to assume that bacteria are not thus easily introduced into milk through the system of the cow.

Another danger from feeding offal is the dissemination of trichinosis among swine. Professor Mark, in the annual report of the Massachusetts State Board of Health for 1888, in commenting upon the high percentage of trichinosed swine among those raised upon city offal in the environment of Boston, makes it appear highly probable that the offal is largely responsible for the extent of this affection. This offal, according to his view, probably contains scraps of uncooked trichinous pork, and of bones to which some of the flesh is still attached.

The main source of trichinosis in the West seem to be the small slaughter-houses in the country districts, in which animals not fit to be sent to Chicago are slaughtered. Here herds of swine are fatted on the offal. There is probably the same condition obtaining in parts of New England. If there is anything valuable in the offal from such slaughter-houses,— and it is undoubtedly nourishing, judging from the growth of the swine that feed upon it,—the boards of health should recommend that it be cooked or brought up to the boiling point; for this would destroy all danger, not only that arising from the presence of animal parasites, but of bacteria as well.

A possible source of danger in times of cholera epidemics is the dissemination of the specific disease germs by flies. These pests are known to void, in a living condition, cholera spirilla consumed twenty-four hours before. Garbage may at such times aid in the distribution of the disease by favoring the multiplication of flies, and, if it contain the disease germs accidentally, may become itself a focus of infection.

To recapitulate briefly, I would state that the larger the territory from which garbage comes, and the larger the herd of swine to which it is fed, the more frequent the opportunity for infectious diseases to appear in the herd. If this be true, the smaller the area from which garbage comes, if not actually infected, the less likelihood of an outbreak of disease. To be sure, it would be safe for any health officer to hold that garbage can be fed after it has been brought up to the temperature of 160° Fahrenheit for at least thirty minutes, which temperature destroys nearly all disease germs. Whether this is desirable or profitable, somebody who has more practical knowledge of animal feeding than I will have to decide.

THE CHAIRMAN.— I should like to hear from Mr. James C. Coffey, of Worcester, in regard to his experience in that city.

REMARKS OF JAMES C. COFFEY, ESQ.

Mr. President,— At this late hour it is unnecessary to take up a great deal of time, because the subject has been covered so well by Dr. Field's paper, and by the other gentlemen who have spoken to the subject. However, perhaps it might be of interest to give my impressions of the matter.

Two years ago, at the request of the City Council of Worcester, I investigated the subject of garbage disposal, visiting a number of cities. I saw all of the systems then in operation, and on my return made a full report to the City Council. Since then some plans have been patented and put upon the market which I have not seen, so that I am not competent to speak of those.

I have a decided opinion that for small cities and towns the cremation system is best. It is the best because it is the least expensive. A city or town may own and control it. As a natural consequence, it is more sanitary than the reduction systems which are on the market. I returned from my trip convinced that the American reduction plants were not sanitary and were expensive, notwithstanding the fact that their promoters were ready to whisper in my ear that a profit of 35 or 40 per cent. was realized on the investment. They were not ready to construct the plant, however, unless they had a contract of from twenty to thirty years, with a large bonus. I never could understand why it was, if the percentage of profits was so large, they were not competing with each other to obtain the garbage from the city, paying for the same.

Dr. Smith is evidently not acquainted with the methods of garbage disposal in Massachusetts. As a matter of fact, the swill is fed almost entirely to swine. The only plant for garbage disposal in the State of Massachusetts is located in Lowell. All the rest of it, except what Boston and Lynn send out to sea, to be returned by the tide, on the beaches, is fed generally to swine.

In Worcester we have 100,000 people in round numbers; and the garbage of the city is fed entirely to swine, which never eat anything else from the time of weaning until they are sent to the slaughter-house.

This year, at the annual inspection of the city farm, an announcement was made that the sale of pork would come within $700 of the entire cost of the collecting and disposing of the garbage for the year. It is needless to say that the Board of Health is on record against this method of disposal because it is not sanitary. It is not surprising, however, that progress is slow in this direction; for a great many systems have failed upon trial, and the authorities have been made cautious in consequence. My own impression is, after seeing the various systems, that the Brown is the best furnace in the market. I saw this furnace in operation in Wilmington, Del., last year. It was during a hot spell in August. I spent about three hours in the building; and the garbage was consumed without reasonable grounds for complaint at a cost, I was told, of about 29 cents per ton. It would cost more here, as labor and coal or oil are dearer here than there. The Brown people at that time offered to sell the city of Worcester a furnace, and guarantee that the cost of consumption would not exceed 45 cents per ton.

The Engle system is, in my judgment, fully as sanitary as the Brown, but more expensive. I saw the Engle in operation at Lowell, at Coney Island, and at the World's Fair; and there is no question about it doing the work satisfactorily and in a sanitary way. It is simply a question of cost.

The reduction process, if at all suitable, is only so for large cities, be-

cause of its ability to dispose of garbage in large quantities. This is where the reduction has an advantage over the burning process, the capacity of the average furnace being only about fifty tons daily. This would necessitate in a large city like New York, which produces about 800 tons of garbage daily, the erection and maintenance of 16 furnaces. The cost of land and the crowded conditions of the buildings might militate against the furnace, and render a reduction plant necessary. Otherwise, it is my opinion that the cremation system is best for towns and cities, the only exception, if any, being the very large cities.

THE CHAIRMAN.—I will call upon Mr. W. F. Morse to say a few words on this subject of garbage disposal.

REMARKS OF W. F. MORSE, ESQ.

Mr. Chairman,—The paper read by Dr. Field covers the whole situation as regards the present methods in use for garbage disposal so completely that I can add nothing to it. The point of the whole question seems to be just here. None of the methods under trial seem to have been fully demonstrated or absolutely and entirely satisfactorily.

Where the systems of reduction and methods of cremation are employed, each have their advocates; but it does not appear that either one or the other has perfectly solved the question. Both methods are going on; and, when they get to the point of efficiency and economy, then municipalities will be prepared to decide which one they prefer.

But what I wanted to say was that, if the garbage can be disposed of in the household without offence and at no extra cost, it would save an enormous sum of money to the cities as well as discomfort and annoyance to the householder.

The question is, Can it be done? We know that it can be done by burning in the range or stove, but we know also that, if we do this, we shall have the nuisance of an offensive discharge from the chimney, and in the end the destruction of the range or stove fittings.

How, then, can it be disposed of in the household without these results?

Three years ago the presiding officer of this meeting said to me: "You are going in the wrong direction in advocating public disposal of waste. Each householder should be in a position to destroy his own waste without extra fuel, and with no nuisance resulting." I replied: "There have been some attempts to do this; but, so far as my investigation shows, these have been failures. At present we cannot accomplish this if we tried."

The matter rested until a year ago, when he suggested an idea which has

now been carried into practical operation, resulting in an improved system of domestic disposal, by first drying or carbonizing the garbage and then burning it, which seems to be entirely reasonable and economical.

If you take fresh kitchen swill, remove it a few feet from the fire-box of the stove or range, and apply a moderate, continuous heat which will not disengage the gases, but will drive off the water, the residuum after this evaporation has been accomplished is a charcoal which will burn readily and quickly in the fire-box, giving a clear, bright flame, supplying in some degree the place of fuel.

If at some point in the stove-pipe before it enters the chimney flue, there is fixed a receptacle around and through which the heat can pass without interference with the draft, and the garbage is placed in this receptacle in such a way as to allow the direct contact of the heat with the material to be dried, the process of evaporation can be carried on without offence, with a minimum amount of trouble, and can be made continuous during the time the heat is in the stove or range.

I have seen this done. I believe this to be a step in advance of real and practical value, both to the municipality and the citizen; and it seems to be an addition of a new system or method of garbage disposal, which ought to be considered whenever this question comes up for examination.

True, there are some difficulties in the way. It may not be possible to apply it to every form of stove or range, especially where gas is in use for fuel; and, in cases where the kitchen apparatus is enclosed in brick, it is somewhat difficult to make proper attachment.

The experimental driers heretofore in use are susceptible of being greatly improved. If there be no serious objection from a sanitary point of view (and this seems to be assured by the evidence of hundreds now in use), and the difficulties encountered can be overcome by the adoption of improved apparatus, the underlying principle of garbage disposal by the surplus heat of the kitchen stove, on the premises, without offence, and with reasonable speed, has certainly been demonstrated as being entirely practicable, a great saving over the public methods of reduction or cremation as at present practised, and is entitled to be taken into account whenever and wherever this matter of garbage disposal is under consideration.

THE CHAIRMAN.— Are there any further remarks to be made? The question is open for general discussion.

DR. F. H. OSGOOD.— Mr. Chairman, in regard to the feeding of garbage to swine: in all the infectious swine diseases that are reported, ninety cases out of a hundred can be traced directly to the feeding of city swill. Of course, where farmers feed their own swill or swill collected in their immediate neighborhood, such a result would rarely occur.

When the Commission are notified of an outbreak of infectious swine diseases, we can almost always trace it to the feeding of swill collected over a large area, and in which are almost always to be found the trimmings of Western pork.

THE CHAIRMAN.— Will Dr. Smith favor us with a few remarks?

DR. THEOBALD SMITH.—I think it safe to say that hog cholera may mean half a dozen different affections caused by several different disease germs, by parasites and by toxic products. The city garbage may, in short, be considered a kind of distributing centre of these diseases. It may receive infectious material from any part of the entire country, and distribute it again to its immediate neighborhood.

THE CHAIRMAN.— I understand that Mr. Brimblecom, of Newton, is present. If so, we would like to have him tell us what is being done with garbage in Newton.

REMARKS OF J. C. BRIMBLECOM, ESQ.

Mr. Chairman and Gentlemen,— Our board has considered this question carefully, and has come to the conclusion that the reduction system is not applicable to our city, and that cremation is the only process which we can recommend.

We are very peculiarly situated, as you all know. As Colonel Higginson has well said, "We are a city upon a circumference," and composed of a number of scattered villages. Consequently, the cost of carting the garbage and other waste is large. We also have a new system of sewers, and many streets not yet sewered, where privies and cesspools are still used, and where considerable trouble is anticipated unless we can dispose of their contents in a more sanitary manner than at present. Our ash-teams collect all sorts of rubbish, which is dumped at various convenient places, and causes considerable nuisance. Our board early came to the conclusion that they must get some system which would dispose of all kinds of rubbish and night soil as well as garbage, and we tried everywhere to obtain such a system. Last winter we came very near recommending the Brown furnace for disposing of everything except ashes. The Brown system is a very good one, indeed, for garbage; and not until the meeting of the American Public Health Association in Montreal, in 1894, did we get any clew where to go for a better. The published reports of that meeting gave us some idea of what they were doing in Montreal and I entered into correspondence with the local authorities, and received replies of such a character that the board went up there last summer.

We arrived at nine in the evening, and at nine the next morning were at the incinerator without the knowledge of any one connected with the plant.

The Thackeray incinerator is so arranged that the waste (which includes ashes, rubbish, and garbage) can be placed immediately into the hoppers, from which it slowly passes into the cells, of which there are 12, each being 6 by 13 feet in size.

As the collection of about 150 tons of waste per day is all made during the night, the accumulations are dumped on one side and fed into the hoppers as required. At the time of our visit, the cells were in the various stages of burning; and the men in charge kindly showed us all the details of the furnace. There was absolutely no odor about the premises; and no fuel is or ever has been used, with the exception that the staves of the cement barrels left over from the construction, in the fall of 1894, were used to start the first fires. The waste lying on the upper part of the grate and in the hoppers is exposed to the heat from the fires in the front of the cells, and thus becomes dried, and becomes fuel to dry that which follows. The only expense connected with the plant is that of the labor necessary to keep the fires in good condition.

The clinkers from the furnace have been used, in part, by the street department of Montreal in road building. This plant does not dispose of night soil, as a separate contract requires it to be burned; and another plant in the outskirts of the city cares for it in a similar manner as the one described. All the waste of a district of 68,000 people is disposed of by the Thackeray incinerator, without offence and at a nominal expense.

Our board has recommended the erection of a Thackeray incinerator in Newton, containing 6 cells, with a stack 150 feet in height, and a capacity of 65 tons of waste and 5 barrels of night soil per twenty-four hours. A steam-boiler will be located in one of the flues, from which enough steam can be generated to work a fan to increase the draft on such days when the weather conditions are bad for the furnace. Such a fan is connected with the Montreal plant, but has never been used. We hope to use the steam generated in our plant for a steam disinfector, when the amount of power has been determined.

This class of incinerators has been in use in England for many years, and we have received full reports of the workings of a similar furnace in a city of 25,000 inhabitants just outside of London.

A small book on Refuse Destructors, by Charles Jones, published in England, gives descriptions of the various systems used in that country, with full details of cost, etc. A report upon the amount of power to be obtained from the incineration of municipal waste, and the utilization of it, is very interesting reading.

I am informed that Mr. Thackeray is now engaged upon plans for another plant for Montreal, in which he alternates boilers with the cells, and intends to develop about 1,500 horse power, to be used in lighting the city with electricity.

You can see the possibilities of this system of incineration, which will also take care of all our municipal waste in a most satisfactory manner.

The discussion being closed, the Secretary, Dr. Farnham, said: Mr. Chairman, I should like to move before we adjourn that the hearty thanks of the Massachusetts Association of Boards of Health be tendered to the town of Brookline for the generous entertainment which they have provided for the Association this afternoon.

The motion was seconded, and adopted unanimously by a rising vote. There being no further business to come before the Association, the meeting was adjourned.

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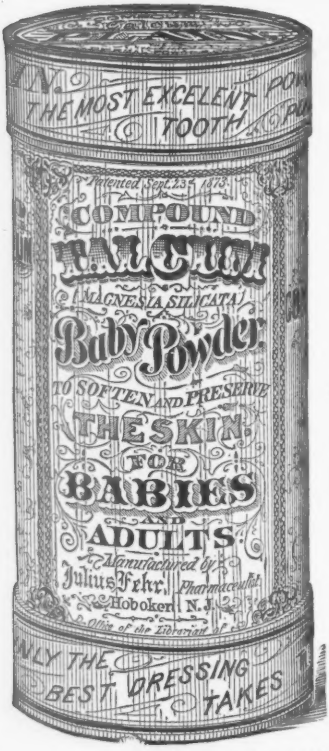

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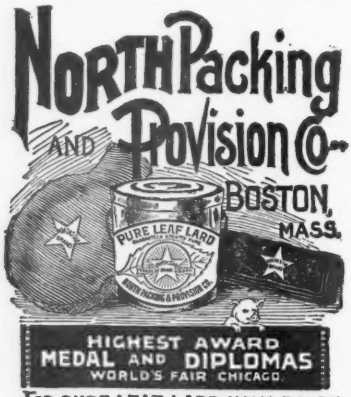

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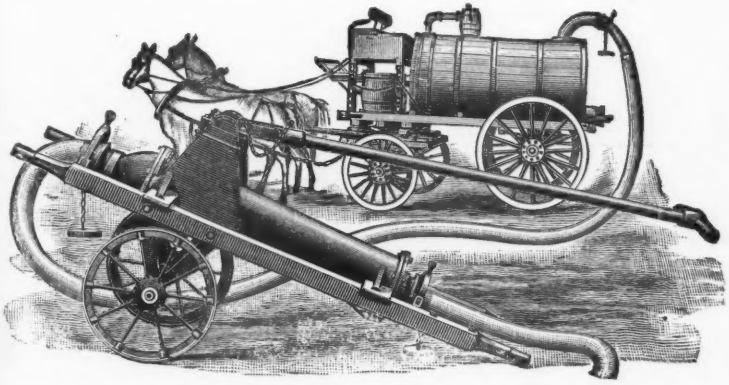

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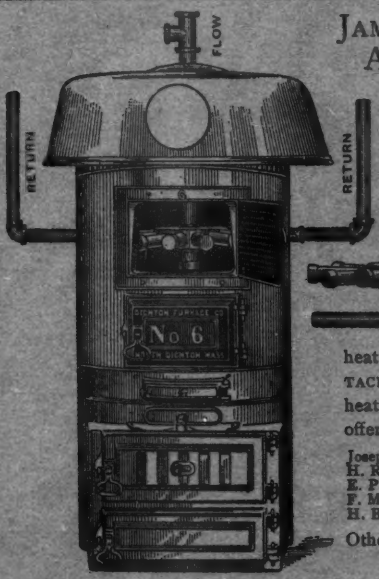

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